

The Multiple Level Fast Multipole Algorithm in the Differential Algebra Framework for Space Charge Field Calculation

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A method will be presented that allows the computation of space charge effects of arbitrary and large distributions of particles in an efficient and accurate way based on a variant of the Fast Multipole Method (FMM). It relies on an automatic multigrid-based decomposition of charges in near and far regions and the use of high-order differential algebra methods to obtain decompositions of far fields that lead to an error that scales with a high power of the order. Given an ensemble of N particles, the method allows the computation of the self-fields of all particles on each other with a computational expense that scales as $O(N)$. The parallel version based on MPI of this algorithm enables us to take advantage of the cluster machine and deal with huge number of particles. Some numerical examples will also be presented.